FIELD MODIFICATION FORM No. 1
FOR
CORNELL-DUBULIER ELECTRONICS SUPERFUND SITE OU-1
THE LOUIS BERGER GROUP/ARCADIS-US-MALCOLM PIRNIE

Date: November 29, 2011

Document: Final Quality Assurance Project Plan (QAPP) Cornell-Dubilier Electronics Superfund Site Operable Unit 1: Vicinity Property Sampling – Phase 2, September 2011

Requested Modification: This field modification describes plans to collect post-excavation soil samples on behalf of the United States Environmental Protection Agency (USEPA) and the United States Army Corps of Engineers (USACE) to confirm the limits of excavation at OU1 properties slated for remediation in the Spring of 2012. The data are needed to ensure that the extent of potential polychlorinated biphenyl (PCB) Aroclor contamination will be removed by the planned excavation. Interior dust samples will also be collected from the dwellings located on the residential properties selected for remediation to confirm previous measurements of interior dust obtained during the Phase 1 and 2 screening level investigations.

It is anticipated that field work will be started in early December 2011 and conclude in mid-to-late December 2011. The individual components of the investigation include soil and interior dust sampling, coordination with the subcontract laboratory, data validation and development of the associated Quality Control Summary Report (QCSR), and preparation of draft and final data characterization reports.

Soil Sampling: Samples at all locations will be obtained using hand auger techniques as outlined in the Final QAPP. A maximum of 255 samples, including soil-associated QC, will be obtained from approximately 141 locations during this event (see attached figures). These samples will be obtained in one or more "rounds" of sampling. A total of 173 samples will be collected during Round 1, and up to 82 samples will be collected during Future Rounds. Future Round sampling will only be conducted if the results yielded by Round 1 samples indicate that the limits of excavation do not meet the Record of Decision (ROD) Total PCB criterion of 1 mg/kg.

The 141 locations can be subdivided into three categories:

- Excavation sidewall confirmation samples, which are placed at a frequency of 1 per 30 linear feet of excavation sidewall. The data from these samples will be used to ensure that the excavation captures the areal extent of PCB-contaminated soil;
- Excavation bottom confirmation samples, which are placed at a frequency of 1 per 900 square feet of excavation area. The data from these samples will be used to ensure that the excavation captures the vertical extent of PCB-contaminated soil; and

- Archive samples, which are placed outside of the excavation areas in limited locations where delineation data are sparse. These samples will be analyzed only if the nearest sidewall sample fails to meet the ROD criterion.

Excavation Area Definitions:

Excavation areas are divided into two different "types" based on anticipated depths of remediation:

- 'Shallow excavations' are areas where soils from 0 to 6 inches will be excavated; and
- 'Deep excavations' are areas where soils from 0 to 24 inches will be excavated.

Sampling associated with each type of excavation area is summarized by round below.

Round 1 Sampling:

The first pass of sampling, as noted above, is referred to as Round 1. The specific sampling to be performed during Round 1 for each excavation area 'type' is summarized as follows (and shown on the attached figures):

Shallow Excavation Areas (0 to 6 inches):

- Sidewall Samples - Round 1 sidewall samples for shallow excavation areas will be collected from the 0 to 6-inch depth interval along the limits of excavation as demarked on preliminary Tier I design drawings.
- Bottom Samples - Round 1 bottom samples for shallow excavation areas will be collected from the 6 to 12-inch depth interval within the limits of excavation (which represents the first six inch depth interval below the bottom of excavation).

Deep Excavation Areas (0 to 24 inches):

- Sidewall Samples - Round 1 sidewall samples for deep excavation areas will be collected from the 9 to 15-inch depth interval along the limits of excavation as demarked on preliminary Tier I design drawings.
- Bottom Samples - Round 1 bottom samples for deep excavation areas will be collected from the 24 to 30-inch depth interval within the limits of excavation (which represents the first six inch depth interval below the bottom of excavation).

In addition to the specific sidewall and bottom samples outlined above, provision is made for limited collection of additional samples outside of the limits of excavation during Round 1. These samples, referred to as 'Archive Samples,' will be collected from approximately six locations where delineation data are sparse. In these instances, samples will be collected in accordance with sidewall sampling depths outlined above, with depths being guided by the nearest excavation area type (i.e., from 0 to 6-inches if the nearest sidewall sample is being collected for a shallow excavation area, or from 9 to 15-inches if the nearest sidewall sample is being collected for a deep excavation area). These samples will be frozen by the lab upon receipt and only analyzed if the nearest sidewall sample results do not meet the ROD criterion.

Note: USEPA may require samples to be collected from within driveway footprints in areas adjacent to currently depicted limits of excavation. If that is necessary, the sampling crew will use a chisel to break through the asphalt and any underlying gravel to expose soil that can be sampled. One sample will then be collected from the first six inch depth interval encountered, and the overall sampling depth interval as measured from the top of the asphalt will be recorded. Asphalt cold patch will be used to repair the area. Should concrete be encountered beneath the asphalt or gravel, sampling at that location will be abandoned and the Project Team will confer on how to proceed.

Future Round Sampling:

If any of the Round 1 analyses yield Total PCB concentrations in excess of ROD criterion, the field crew will return to collect additional samples for analysis in accordance with the following:

- Bottom Samples – Where Round 1 bottom samples contain Total PCB concentrations in excess of ROD criterion, the sampling crew will return to the location(s) where the exceeding samples were obtained and collect two additional samples starting at depths immediately below the Round 1 sample. In shallow excavation areas where the 6 to 12-inch depth interval was sampled during Round 1, two samples will be collected corresponding to the 12 to 18-inch and 18 to 24-inch depth intervals. In deep excavation areas where the 24 to 30-inch depth interval was sampled during Round 1, two samples will be collected corresponding to the 30 to 36-inch and 36 to 42-inch depth intervals. The sample from the shallower interval will be analyzed immediately, and the sample from the deeper interval will be archived. This deeper sample will be analyzed only if the shallower sample exceeds the ROD criterion. This collection and analysis process will continue with additional rounds of sampling at continuously deeper sampling intervals until a sample with Total PCBs less than 1 mg/kg is obtained.
- Sidewall Samples – Where Round 1 sidewall samples contain Total PCB concentrations in excess of ROD criterion, the Project Team (USACE/USEPA/LBG) will confer and determine where to collect additional samples outside of the current limit of excavation. If the sidewall sample exceeding ROD criterion is at a physical barrier such as a building foundation, a walkway, or a road, sampling will be deemed complete as excavation will be restricted by the physical barrier. If the sidewall sample exceeding ROD criterion has open space adjacent to it and the limit of excavation can be expanded in that direction, then additional samples will be collected from within that open space. The intent of these additional samples will be to refine the limit of excavation such that a clean sidewall sample can be collected. The lateral distance from the original exceeding sample will be determined on a case-by-case basis. For areas adjacent to shallow excavation areas, the additional samples will be collected from the 0 to 6-inch depth interval. For areas adjacent to deep excavation areas, the additional samples will be collected from the 9 to 15-inch depth interval. This collection and analysis process (i.e., moving laterally outward from sidewall samples that exceed ROD criterion) will continue with additional rounds of sampling at progressively more distant locations until a sample with Total PCBs less than 1 mg/kg is obtained OR a physical barrier (i.e., building foundation, a walkway, or a road) is encountered. Should sidewall sampling greatly increase the overall footprint of any particular excavation area, the Project Team will collectively determine whether additional/deeper bottom samples are warranted in order to meet post-excavation bottom sampling requirements.

Additional information:
QA/QC samples, including rinsates, will be collected as appropriate (see Worksheets 20 and 28); all boring locations will be selected based on NJDEP criteria and located in the field using preliminary Tier I design drawings developed by the USACE-KCD. Following the collection of samples, each boring location will be surveyed by a surveyor licensed in the State of New Jersey.

To expedite this new phase of the program, and as agreed upon by the USEPA and USACE, the soil samples will be analyzed by a subcontract laboratory (Test America, Burlington) by method SW-846-8082A with a requested turn-around time of three days for preliminary data. As documented in a revised Worksheet 15, Test America reporting limits for PCBs by SW846-8082A are below than the project action level. A copy of the Test America Burlington's laboratory procedure for 8082A is given in Attachment 1.

Dust Sampling: The collection of additional interior dust samples at OU1 properties is anticipated to begin in December. Dust sampling will be performed within the home at each property at which soil sampling is performed, as well as those properties where the Phase 2 dust results exceeded the ROD criterion. At this time, the number of samples to be collected is estimated to be 28 dust samples plus QA/QC. It is anticipated that samples will be collected from active living areas within each residence, with potentially a second sample collected from specific areas identified during previous sampling. LBG will coordinate the sample collection schedule with the USEPA to ensure that the USEPA is available on-site to aid in sample location selection. Test American Burlington estimates that they can provide 15-day turn-around time for preliminary PCB results in the dust samples. The dust samples will be collected on vacuum filters and the material will be sieved by the laboratory as described in the Phase 2 QAPP. The dust will then be analyzed for PCB Aroclors by USEPA method SW-846 8082A.

Key QAPP Worksheets are included in Attachments 2 through 6 documenting the requirements sample analysis, QCs, sample preservation and data validation.

Rationale: Post-excavation soil samples will be collected at OU-1 properties scheduled for remediation in Spring 2012 to confirm that the limits of excavation will remove all PCB-contaminated soils from the property. Interior dust samples will also be collected from the dwellings located on the residential properties selected for remediation to confirm previous measurements of interior dust obtained during the Phase 1 and 2 screening level investigations.

Attachments:

Attachment 1- Test America Burlington SOP No. BR-GC-005, Rev. 11,
Polychlorinated Biphenyls (PCBs) by GC/ECD (SW846 8082A), April 1, 2011.

Attachment 2- QAPP Worksheet 15, Reference Limits and Evaluation Table for SW-846 8082A.

Attachment 3- QAPP Worksheet 19, Analytical SOP Requirements Table

Attachment 4- QAPP Worksheet 20, Field Quality Control Summary Tables

Attachment 5-QAPP Worksheet 28, Sample QC Requirements

Attachment 6-QAPP Worksheet 36, Data Validation Requirements

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The Louis Berger Group, Inc. Deputy Project Manager:_____

James McCann
ARCADIS-US/Malcolm Pirnie Site Quality Control Officer:_____

64 sampling locations
5 archive sample locations

TABLE - 1a EXCAVATION COORDINATE TABLE		
EXCAVATION POINT	Y=NORTHING	X=EASTING
A1	634412	515618
A2	634369	515587
A3	634357	515604
A4	634352	515616
A5	634392	515645
B1	634349	515573
B2	634344	515580
B3	634352	515586
B4	634357	515578
C1	634326	515683
C2	634281	515649
C3	634305	515617
C4	634293	515608
C5	634240	515682
C6	634258	515694
C7	634260	515691
C8	634256	515663
C9	634274	515676
C10	634287	515661
C11	634304	515674
C12	634302	515676
C13	634320	515689
D1	634417	515622
D2	634415	515620
D3	634374	515677
D4	634377	515678
E1	634365	515683
E2	634346	515668
E3	634328	515692
E4	634328	515713
E5	634338	515720
F1	634290	515698
F2	634283	515693
F3	634277	515702
F4	634283	515707
G1	634267	515697
G2	634260	515691
G3	634258	515694
G4	634265	515699

NOTE:
1. COORDINATES CURRENTLY INCLUDED IN TABLE 1a SHOULD BE CONSIDERED PLACEHOLDERS AND MAY CHANGE BASED ON SURVEY DATA CONFIRMATION.

TABLE 1b – VOLUME OF EXCAVATION			
AREA	SQ. FT.	PRIMARY	SECONDARY
A	1755.72		
B	87.76		
C	1538.18		
D	255.07		
E	966.35		
F	85.71		
G	30.89		

MALCOLM PIRNIE

U.S. Army Corps of Engineers
KANSAS CITY DISTRICT

REVISIONS:

No.	Date	Remarks

PROJECT NAME: OU-1 REMEDIAL DESIGN CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, NEW JERSEY

SHEET TITLE: PROPERTY 108 & 129 EXCAVATION PLAN

JOB NO:

CONTRACT NO:

SHEET NAME:	DRAWN BY: K. IAMICELI
FIGURE 1A	DESIGNED BY: A. MASON
	CHECKED BY: B. GIRARD
SHEET 6 OF 11	
FILE NAME:	DATE: SEPTEMBER 2011

DRAFT

23 primary sampling locations
1 archive sample location

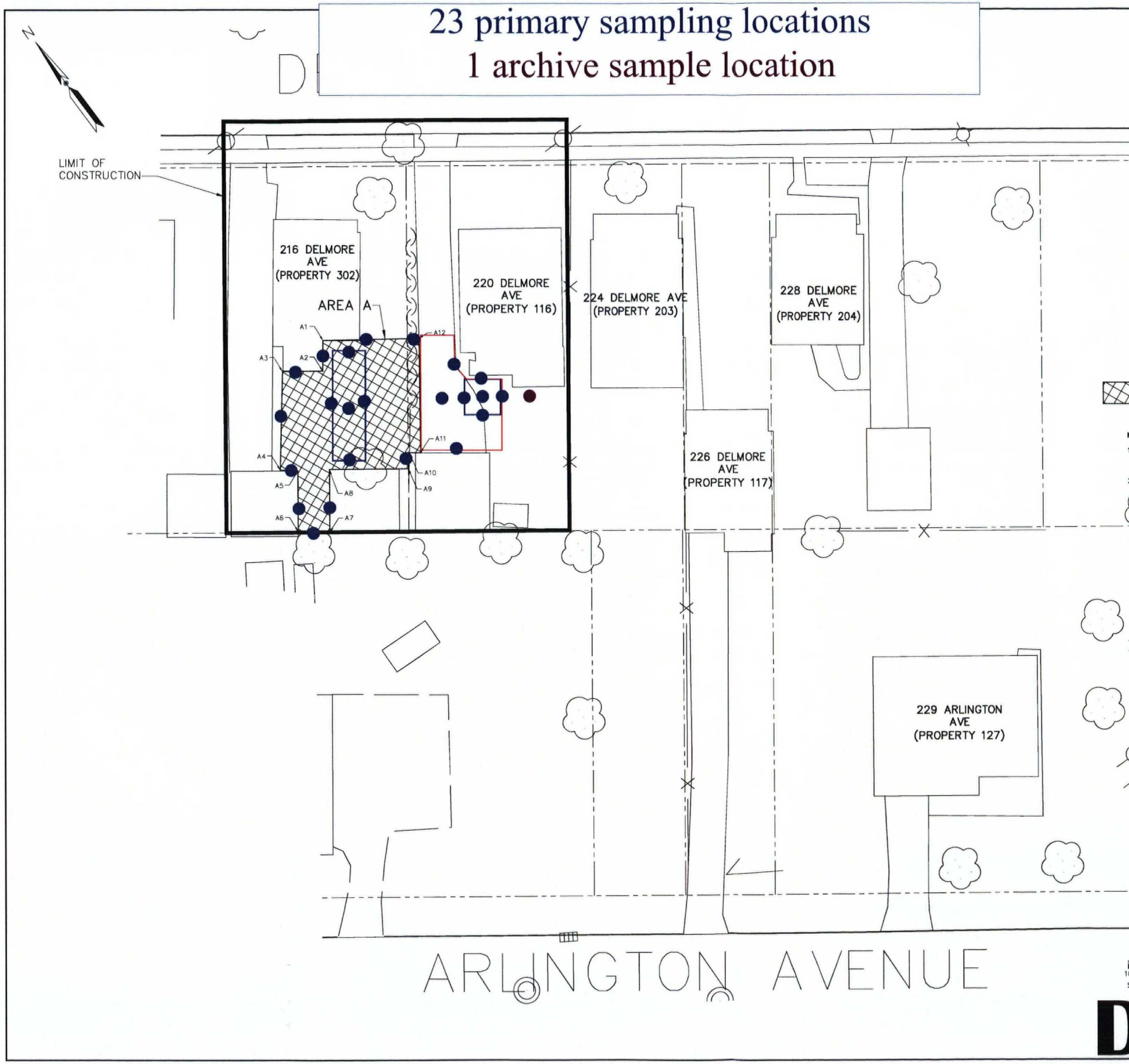

TABLE 2a - EXCAVATION COORDINATES		
EXCAVATION POINT	Y=NORTHING	X=EASTING
A1	633888	516263
A2	633882	516258
A3	633888	516249
A4	633867	516232
A5	633864	516236
A6	633850	516226
A7	633845	516233
A8	633859	516243
A9	633846	516261
A10	633850	516264
A11	633848	516266
A12	633874	516284

NOTE:

1. COORDINATES CURRENTLY INCLUDED IN TABLE 3a SHOULD BE CONSIDERED PLACEHOLDERS AND MAY CHANGE BASED ON SURVEY DATA CONFIRMATION.

TABLE 2b – VOLUME OF EXCAVATION			
AREA	SQ. FT.	PRIMARY	SECONDARY
A	1382.21		

LEGEND

INDICATES PRIMARY EXCAVATION AREA TO 6" BELOW GROUND SURFACE (BGS) WITH POTENTIAL SECONDARY EXCAVATION TO 12" BGS

NOTES:

1. APPROXIMATE CUT LINES. ADDITIONAL SAMPLING TO BE PERFORMED BY OTHERS TO DELINEATE FINAL CUT LINES.
2. COORDINATES FOR LAYOUT OF THE EXCAVATION AREAS ARE PROVIDED IN TABLE 2a. COORDINATES MAY CHANGE BASED ON SURVEY DATA CONFIRMATION.

GRAPHIC SCALE

10' 0 10' 20' 30'

SCALE: 1"= 10'-0"

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MALCOLM PIRNIE

REVISIONS:

No.	Date	Remarks

U.S. Army Corps of Engineers
KANSAS CITY DISTRICT

PROJECT NAME: OU-1 REMEDIAL DESIGN CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, NEW JERSEY

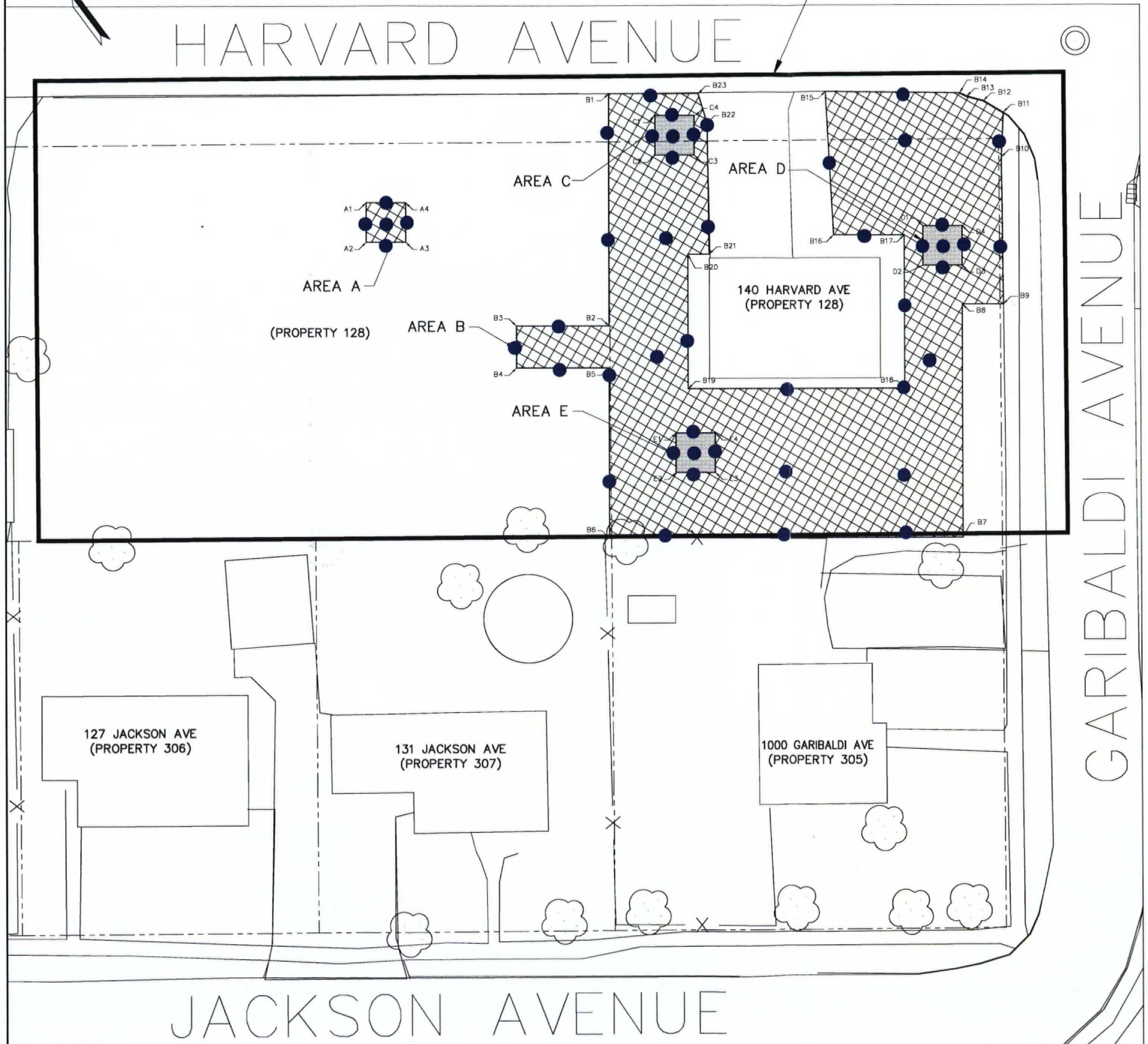
SHEET TITLE: PROPERTY 116 & 302 EXCAVATION PLAN

JOB NO:

CONTRACT NO:

SHEET NAME: FIGURE 2A	DRAWN BY: K. IAMICELI
	DESIGNED BY: A. MASON
SHEET 8 OF 11	CHECKED BY: B. GIRARD
FILE NAME:	DATE: SEPTEMBER 2011

48 sampling locations



LEGEND

INDICATES PRIMARY EXCAVATION AREA TO 6" BELOW GROUND SURFACE (BGS) WITH POTENTIAL SECONDARY EXCAVATION TO 12" BGS

INDICATES PRIMARY EXCAVATION AREA TO 24" BELOW GROUND SURFACE (BGS) WITH POTENTIAL SECONDARY EXCAVATION TO 36" BGS

NOTES:

1. APPROXIMATE CUT LINES. ADDITIONAL SAMPLING TO BE PERFORMED BY OTHERS TO DELINEATE FINAL CUT LINES.
2. COORDINATES FOR LAYOUT OF THE EXCAVATION AREAS ARE PROVIDED IN TABLE 3a. COORDINATES MAY CHANGE BASED ON SURVEY DATA CONFIRMATION.

TABLE 3a - EXCAVATION POINTS

EXCAVATION POINT	Y=NORTHING	X=EASTING
A1	633358	515343
A2	633350	515337
A3	633344	515345
A4	633352	515351
B1	633344	515408
B2	633296	515374
B3	633310	515355
B4	633301	515349
B5	633288	515368
B6	633253	515342
B7	633200	515416
B8	633247	515450
B9	633241	515459
B10	633272	515480
B11	633280	515487
B12	633286	515485
B13	633289	515482
B14	633291	515481
B15	633312	515454
B16	633281	515434
B17	633270	515449
B18	633239	515426
B19	633272	515381
B20	633299	515401
B21	633296	515405
B22	633323	515424
B23	633330	515427
C1	633332	515415
C2	633324	515409
C3	633318	515417
C4	633327	515423
D1	633269	515454
D2	633261	515448
D3	633255	515456
D4	633263	515462
E1	633264	515372
E2	633256	515366
E3	633250	515374
E4	633258	515380

NOTE:

1. COORDINATES CURRENTLY INCLUDED IN TABLE 3a SHOULD BE CONSIDERED PLACEHOLDERS AND MAY CHANGE BASED ON SURVEY DATA CONFIRMATION.

TABLE 3b – VOLUME OF EXCAVATION

AREA	SQ. FT.	PRIMARY	SECONDARY
A	100		
B	7371.24		
C	100		
D	100		
E	100		

GRAPHIC SCALE

10' 0 10' 20' 30'

SCALE: 1"= 10'-0"

DRAFT

MALCOLM PIRNIE

REVISIONS:

No.	Date	Remarks

U.S. Army Corps of Engineers
KANSAS CITY DISTRICT

PROJECT NAME: OU-1 REMEDIAL DESIGN CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE SOUTH PLAINFIELD, NEW JERSEY

SHEET TITLE: PROPERTY 128 & 304 EXCAVATION PLAN

JOB NO:

CONTRACT NO:

SHEET NAME: FIGURE 3A	DRAWN BY: K. IAMICELI
	DESIGNED BY: A. MASON
SHEET 10 OF 11	CHECKED BY: B. GIRARD
FILE NAME:	DATE: SEPTEMBER 2011

Title: Polychlorinated Biphenyls (PCBs) by GC/ECD (SW846 8082A)

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Facility Distribution No. Electronic **Distributed To: Facility Intranet**

The controlled copy of this SOP is the PDF copy of the SOP that is posted to the laboratory's SOP Directory. Printed copies of this SOP or electronic copies of this SOP distributed outside the facility are considered uncontrolled.

1.0 Scope and Application

This SOP describes the laboratory procedure used to determine the concentration of polychlorinated biphenyls (PCBs) as Aroclors using dual column gas chromatography with electron capture detectors (GC/ECD).

This SOP is applicable to instrument analysis only. Extraction and extract cleanup procedures are provided in separate SOPs.

1.1 Analytes, Matrices, and Reporting Limits

This procedure may be used for a variety of matrices including: water, soil, sediment and tissue.

The list of target compounds that can be determined from this method along with the associated reporting limits (RL) is provided in Table 1.

2.0 Summary of Method

2 uL of extract is injected into a dual capillary column gas chromatograph equipped with electron capture detectors (GC/ECD). The chromatographic data is used to determine the list of analytes provided in Table 1.

This SOP is based on the following reference method:

- SW-846 Method 8082A Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Revision 0, February 2007.

If the laboratory procedure is modified from the above reference method, a list of modifications will be provided in Section 16.0 of this SOP.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

- Method interference may be caused by contaminants in the extraction solvent. Solvents should be stored away from organochlorine compounds to minimize contamination.

- Non-target compounds co-extracted from the sample matrix can also cause interference, the extent of which will vary depending on the nature of the samples. Elemental sulfur is often found in sediment samples and its presence will result in broad peaks. Samples are screened prior to analysis, and those samples that contain high levels of sulfur are subject to sulfur cleanup (SW-846 3660B). Cleanup procedures that may be used for this method include: GPC (SW-846-3640A), silica gel (SW-846 3630C), Florisil (SW-846 3620B), and Sulfuric acid Cleanup (SW-846 3665A).

- Phthalate esters introduced during sample preparation can pose a problem in the determination of target analytes. Common flexible plastics contain varying amounts of

phthalate esters. These phthalate esters can be easily extracted or leached during extraction. To minimize this interference, avoid contact with any plastic materials.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats, and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The gas chromatograph contains zones that have elevated temperatures. The analyst must be aware of the locations of those zones and must cool them to room temperature prior to working on them.

There are areas of high voltage in the gas chromatograph. Depending on the type of work involved, either turn the power to the instrument off or disconnect it from its source of power.

5.2 Primary Materials Used

Table 2 lists materials used in this method which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Autosampler Vials, National Scientific or equivalent.
- Hydrogen Generator: Parker Balston.
- Volumetric Syringes, Class "A" (10µl, 25µl, 50µl, 100µl, 250µl and 500µl), Hamilton or equivalent.

6.2 Analytical System

- Computer Hardware/Software: GC Acquisition Platform - VAX 4505 (GVAX) Multichrom V2.11. Data Processing - Hewlett-Packard 9000-series computers, an HP 9000 K200 (Chemsvr5)/ HP-UX 10.20 and Target V3.5 or higher.

- GC/ECD: with dual columns, dual ECDs, and auto-sampler capable of a 2-µl injection split onto two columns: HP 5890 with Leap Technology CTC A200SE and A200S Fisons autosamplers, Agilent Technologies 6890N with 7683 Series injector, or equivalent.
- GC Columns: A dual fused silica capillary column system that will provide simultaneous primary and confirmation analyses:
    - RTX-5, (30m x 0.25 mmID x 0.25um)
    - RTX-35, (30m x 0.25 mmID x 0.25um)

Equivalent columns may be used provided the elution orders are documented and compound separations are maintained.

7.0 Reagents and Standards

7.1 Reagents

- Hexane, Ultra-Resi Analyzed, JT Baker or equivalent.

7.2 Standards

Purchase stock standard solutions from commercial vendors and from these prepare calibration and working standards by diluting a known volume of stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection, so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method. Listed below are minimum sample size, preservation, and holding time requirements needed for this test.

Matrix	Sample Container	Minimum Sample Size	Preservation	Extract Holding Time	Reference
Water	Glass	1 L	Chilled to 4°C	40 Days	SW-846 8082A
Solid	Glass	50 g	Chilled to 4°C	40 Days	SW-846 8082A

[1]Analytical holding time is determined from date of initiation of extraction.

Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3

Matrix Spike(s) MS/MSD	Client Request	See Table 3
Sample Duplicate (SD)	Client Request	See Table 3

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Table 3
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Table 3
Continuing Calibration Verification (CCV)	Daily, every 10 samples, end of sequence	See Table 3
Retention Time Windows	As Needed	See Table 3

10.0 Procedure

10.1 Instrument Operating Conditions

Install a five meter deactivated guard column into the injection port and connect the guard column to the separate analytical columns using a glass "Y". The analytical columns are installed into independent ECD detectors.

The recommended instrument operating conditions are as follows:

Initial Temperature:	130°C for 1 minute Temperature Program: 20°C per minute to 190°C to 5°C per minute to 225°C to 20.0°C per minute to 300°C. Hold for 6 minutes.
Detector Temperature	300°C
Injector Temperature:	200°C
Injection volume:	2µL
Carrier Gas:	Hydrogen (supplied by hydrogen generators)

Optimize the flow rate of the carrier gas by injecting an un-retained substance onto the column at an isothermal oven state and adjusting the flow to obtain the recommended dead volume time.

10.2 Retention Time Window Establishment

Whenever a new GC column is installed, establish RT windows for each analyte by analyzing three standards over a 72-hour period. Calculate the mean RT and Standard Deviation (SD). The RT window is calculated as the mean RT $\pm$ 3SD. If the SD is <0.01 minutes, a default SD of 0.01 minutes may be used.

If this procedure results in RT windows that are too tight, favoring false negatives, the laboratory may opt to use an alternate method to determine the RT windows. An alternate method consists of using a RT window of $\pm$ 0.05 minutes. The center of the RT window is set at the midpoint calibration level in the initial calibration sequence. RT windows are then updated daily (minimum frequency), re-centering the windows on the retention times established in a CCV.

10.3 Instrument Calibration

10.3.1 Initial Calibration (ICAL)

Clean the injection port and column with a hexane instrument blank prior to calibration.

To calibrate the instrument analyze a standard containing a mixture of Aroclor 1016 and Aroclor1260 (AR1660) at a minimum of five concentrations and use this multi-point calibration to determine the concentration of AR1016 and AR1260 in sample.

The mixed AR1660 standard includes most of the peaks represented in the other Aroclors so the multi-point calibration can also be used to demonstrate linearity of the instrument and that a sample does not contain peaks that represent the other Aroclors but it is not sufficient for pattern recognition. For the remaining Aroclors analyze a single-point standard at a concentration near the mid-point of the calibration and use these standards for pattern recognition and calculation of a single-point calibration factor. The laboratory does not perform a multi-point calibration for the remaining Aroclors unless requested for the project or by regulatory requirement.

Prepare the calibration standards using the formulations provided in Appendix B then transfer ~100 ugL to an autosampler vial insert. Place the vials in the autosampler, set the autosampler to inject 2-µl of each standard onto the instrument and initiate the analytical sequence.

A minimum of 3 peaks must be chosen for each Aroclor, and preferably 5 peaks. The peaks must be characteristic of the Aroclor in question. Choose peaks in the Aroclor standards that are at least 25% of the height of the largest Aroclor peak. For each Aroclor, the set of 3 to 5 peaks should include at least one peak that is unique to that Aroclor. Use at least five peaks for the Aroclor 1016/1260 mixture.

The data processing system calculates the Calibration Factor (CF), mean CF, and Percent Relative Standard Deviation (%RSD) for each analyte on both columns. The %RSD for each target analyte must be less than or equal to 20% in order to use the mean CF for quantification. This evaluation is performed for each quantitation peak chosen for each Aroclor. All peaks must pass the 20% evaluation, not the average of the 5 peaks chosen for quantitation. If this criterion is not met, use another suitable quantification method for that analyte or correct the problem and repeat the calibration. Once a method of quantification is chosen for a specific compound, it must be consistent throughout the entire analytical sequence until a new initial calibration is performed.

The calibration factor is used to determine the linearity of the calibration.

Alternate Quantification Option:

Linear Regression: Generate a curve of concentration vs. response for each analyte and calculate the correlation coefficient. The calibration must have a correlation coefficient (r) $\geq$ 0.995. If this criterion is not met, correct the problem and repeat the calibration. The use of linear regression requires a minimum of 5 calibration points.

10.3.2 Second Source Calibration Verification (ICV)

Immediately after each calibration and prior to the analysis of any QC or field samples, verify the accuracy of the initial calibration by analyzing a second source ICV.

Prepare the ICV using the formulation provided in Appendix B. Inject 2 µl of the ICV standard onto the instrument in the same manner as performed for the initial calibration standards.

The percent recovery of the average concentration of the peaks chosen for quantitation must be within ± 20% of the expected value (%R 80-120). If this criterion is not met, correct the problem and reanalyze the ICV. If reanalysis fails, remake the calibration standards and/or perform instrument maintenance and recalibrate. The acceptance criteria must be met on both columns.

10.3.3 Continuing Calibration Verification (CCV)

Analyze a CCV (1660) at or below the mid-calibration range each day before sample analysis, after every ten sample injections and at the end of each analytical sequence.

Note: The laboratory does not perform a CCV for the remaining Aroclors unless requested for the project or by regulatory requirement.

The data system calculates the calibration factor (CF) and percent difference using the average percent difference of the peaks chosen for quantitation.

The percent difference or drift must be within ±20% and the retention time (RT) must be within the established RT window. Acceptance criteria must be met on both columns.

If the CCV fails, it may be repeated once. If repeat analysis fails, corrective action must be taken. If the two CCVs do not meet the criteria, recalibration is required prior to running samples. Samples must be bracketed by passing CCVs. Samples analyzed before and after CCV failures must be reanalyzed, unless the CCV is high and there are no detects in the associated samples. (NELAC Requirement)

10.4 Troubleshooting

Check the following items in case of calibration failures:

- ICAL Failure – Perform injection port maintenance, install new guard column, check detector ends to see if detector jet has slipped. In extreme cases, install new columns, particularly if the chromatography has degraded as evidenced by peak shapes.
- CCV Failure – Perform Injection port maintenance; if injection port maintenance does not restore CCV, install a new guard column and remove one or more loops from each analytical column.
- Needle crushed during injection - Replace the needle and check the injection port for obstructions and check the autosampler for misalignment.
- Auto-sampler failure - Reset the auto-sampler.
- Power failure - Reset run in Multichrom and re-acquire or re-initiate run sequence.

10.5 Analysis

Remove the extract from refrigerated storage and warm to room temperature.

Transfer approximately 100 uL of extract to an autosampler vial and place the vials in the autosampler in a sequence that begins with the calibration standards followed by the analysis of an ICV, QC samples, field samples and continuing calibration verification standards (CCVs).

Enter the sample ID's into the data acquisition program in the order that the samples were placed in the autosampler tray and initiate the analytical sequence.

An example analytical sequence that includes calibration is as follows:

Injection Number	Lab Description
1	Instrument Blank
2	Instrument Blank
3	Instrument Blank
4	AR1221 (200 ppb)
5	AR1232 (200 ppb)
6	AR1242 (200 ppb)
7	AR1248 (200 ppb)
8	AR1254 (200 ppb)
9	AR1262 (200 ppb)
10	AR1268 (200 ppb)
11	AR1660 (50 ppb)
12	AR1660 (100 ppb)
13	AR1660 (200 ppb)
14	AR1660 (400 ppb)
15	AR1660 (800 ppb)
16	Instrument Blank
17	ICV
18-27	10 injections
28	CCV (AR1660 200ppb)
	Repeat steps 18-28

Cleaning blanks (IBLK) consisting of hexane may be analyzed after high-level samples at the discretion of the analyst.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data processing system identifies the target analytes by comparing the retention time of the peaks to the established retention time windows.

Review and accept or reject the qualitative identifications made by the data processing system using the following guidelines:

Compare the retention time of the peak to the established RT window, taking into account the shift of the surrogate peaks. If the surrogate peaks have shifted, open the retention time window in the direction of the shift. The processing system identifies the peak in the retention time window that is closest to the expected retention time set in the Target method, so the peak may need to be re-identified if a shift has occurred. The data system does not recognize Aroclor patterns. The analyst manually identifies Aroclors by comparing the pattern in the samples to the patterns in the initial calibration standards. Weathering of PCB's in the environment may alter the PCB's to the point that the pattern no longer matches the pattern established for that Aroclor in

the initial calibration. The laboratory takes the best pattern match approach to the identification and quantification of weathered PCB's.

Look for shoulders on the side of large peaks that may be peaks of interest. The processing system does not always automatically integrate shoulders from larger peaks, so manual integration (split) of the shoulder may be necessary.

Each target analyte must be detected on each column for qualitative identification to be made.

11.2 Quantitative Identification

Using an average of the chosen quantification peaks per Aroclor the data system calculates the corrected concentration for each target analyte using the equations given in Appendix C. If sample interference is suspected, the laboratory may remove up to two quantification peaks per column. The higher value between the two columns is reported as the primary result unless there is evidence of chromatographic anomalies, in which case the lower value will be reported. This deviation must be noted in the project narrative.

11.3 Calculations

See Appendix C.

11.4 Data Review

See laboratory SOP BR-QA-019 for data review requirements.

11.4.1 Primary Review

Review project documents to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Confirm qualitative and quantitative identification criteria using the criteria provided in Sections 11.1 and 11.2. If the data system does not properly integrate the peaks perform manual integration in accordance with laboratory SOP BR-QA-006.

Upload the data files from the data processing system to the laboratory information management system (TALS). Complete the batch information for standards and reagents and verify ICAL and QC sample associations. Review the results and set results to primary, secondary, acceptable or rejected as appropriate. Dilute and reanalyze samples whose results exceed the calibration range. The dilution analysis should result in a determination within the calibration range, preferably in the upper half of the calibration range. A more concentrated analysis is not necessary unless the project requires it. Dilution analyses may be performed to minimize matrix interference.

If a sample was analyzed immediately following a high concentration sample, review the results of the sample for any sign of carryover. If carryover is suspected, reanalyze the sample.

Create a non-conformance report (NCM) for any calibration, QC and sample data that is reported outside established acceptance criteria and/or schedule necessary corrective action. Set batch to 1st level review and complete the data review checklist.

11.4.2 Secondary Data Review

Verify quantitative and qualitative identification in the initial calibration standards and spot check such for ~15% of the remaining data in the batch.

If manual integrations were performed:

- Review each integration to verify that the integration meets the requirements for manual integration as specified in laboratory SOP BR-QA-006. If an error is suspected or found consult with the analyst that performed the integration analyst and request correction or notify the Department Manager, Technical Director or QA Manager. Do not "fix" the integration. Reintegration by a secondary data reviewer must not be performed except in limited circumstances as approved by the department supervisor or other laboratory management. If those instances where the secondary reviewer performs the integration, this person is now considered the primary analyst and each integration performed by the secondary reviewer must be subsequently reviewed by a peer analyst or the department supervisor to verify the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-006.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in laboratory SOP BR-QA-005.

Review project documents to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Verify that the acceptance criteria for the calibration and QC items listed in Table 1 were met. If the results do not fall within the established limits verify the recommended corrective actions were performed. If not, initiate corrective actions and/or verify an NCM was created to document the criteria exception. Verify analytical results are qualified accordingly. Set batch to 2nd level review and complete the data review checklist.

11.5 Data Reporting

The report format, application of data qualifiers and creation of the data deliverable is performed by the LIMS using the formatter set by the project manager during log-in.

Records of electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014.

12.0 Method Performance

12.1 Limit of Detection (LOD) and Limit of Quantitation (LOQ)

Establish a LOD and LOQ at initial method set up following the procedures specified in laboratory SOP BR-QA-005. Verify the LOD and LOQ at the frequency established for the method using the procedures specified in same SOP. The frequency of LOD and LOQ verification depends on the strictest frequency of the regulatory program for which the method supports. The frequency requirement is documented in a spreadsheet maintained by the QA Department.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of the SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

14.1 Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts: Satellite container: 15 gallon bucket connected to a fume hood.
- Solvent Waste: Satellite container: 1 L glass bottle located in fume hood.

15.0 References / Cross-References

- SW-846 Method 8082A Polychlorinated Biphenyls (PCBs) by Gas Chromatography, Revision 0, February 2007.
- Corporate Environmental Health and Safety Manual (CW-E-M-001)
- Laboratory SOP BR-QA-011
- Laboratory SOP BR-LP-011
- Laboratory SOP BR-QA-014
- Laboratory SOP BR-QA-006
- Laboratory SOP BR-QA-005

16.0 Method Modifications

Not applicable.

17.0 Attachments

- Table 1: Target Compound List and Reporting Limit
- Table 1A: Accuracy and Precision Limits
- Table 2: Primary Materials Used
- Table 3: QC Summary & Recommended Corrective Action
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History

BR-GC-005, Rev. 11:

- Title Page: Updated method reference
- Section 2.0: Updated method reference
- Section 10.3: Changed CCV criteria from 15% to 20%
- Table 3: Changed CCV criteria from 15% to 20%

BR-GC-005, Rev. 10:

- Updated approval signatures
- Section 10: Inserted note regarding multi-point calibrations for other Aroclors.

BR-GC-005, Rev. 9

- Updated reference method in Section 2.0.
- Changed QC criteria for %D from 15% to 20%.
- Added language to Section 10.2 to allow for updating RT windows using CCVs.
- Added language to Section 11.4.1 to allow for dilution to minimize matrix interference.
- Added standard preparation tables to Appendix B to allow for the preparation of 5 point calibrations for each of the Aroclors

Table 1: Routine Target Analyte List & Reporting Limits (RL)

ANALYTE	Routine Reporting Limit (RL)[1,2]	
	Water (ug/L)	Solid (ug/Kg)
AR1016	0.50	17
AR1221	0.50	17
AR1232	0.50	17
AR1242	0.50	17
AR1248	0.50	17
AR1254	0.50	17
AR1260	0.50	17
AR1262	0.50	17
AR1268	0.50	17

[1] *The routine RL is the unadjusted value that can be achieved in a blank matrix.*
[2] *The RL for tissue matrix is project defined.*

Table 1A: Routine Accuracy and Precision Limits[1]

Analyte	In-House Limits (%R)		Precision (RPD) (≤)
	Water	Solid	
AR1016	55-120	55-120	30
AR1260	60-125	55-125	30
Surrogate: Decachlorobiphenyl (DCB)	30-150	45-125	NA
Surrogate:TCX (Advisory)[2]	55-120	30-130	NA

[1] *The limits in this table are those used as of the effective date of this SOP. Current limits are stored in the LIMS database.*
[2] *The control limits for TCX are advisory. Corrective action is not performed when recovery is outside limits.*

Table 2: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and symptoms of exposure
Hexane	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.

[1] *Always add acid to water to prevent violent reactions.*
[2] *Exposure limit refers to the OSHA regulatory exposure limit.*

Table 3: QC Summary, Frequency, Acceptance Criteria and Recommended Corrective Action

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	Option 1: RSD for each analyte ≤ 20% Option 2: Linear Regression: r ≥ 0.995	Correct problem, reanalyze, repeat calibration.
ICV	After each initial calibration	(% R) ± 20% from expected value	Correct problem and verify second source standard. If that fails, repeat initial calibration.
CCV	Daily before sample analysis, every 10 samples and at the end of the analytical sequence	% Difference or Drift ±20%	See Section 10.3
MB	One per extraction batch of 20 or fewer samples	Target Analyte < RL	Examine project DQO's and take appropriate corrective action, which may include re-analysis of MB, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. If there are no detects in samples, or if all detects are > 10 X MB level, re-prep and reanalysis may not be required.
LCS	One per extraction batch of 20 or fewer samples	See Table 1A	Examine project DQO's and take appropriate corrective action, which may include re-analysis of LCS, re-extraction of batch, and/or non-conformance report (NCR). Corrective action must be documented on NCR. Flag all reported values outside of control limits.
MS/MSD SD	Per client request	See Table 1A	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze and/or re-extract. Flag all reported values outside of control limits.
Surrogate	All field and QC samples	See Table 1A	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-analyze or re-extract. If matrix effect, review project DQOs to determine if a matrix effect must be confirmed by re-analysis. Flag all reported values outside of control limits.

[1] *The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers.*

Appendix A: Terms and Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are only produced in this range and qualified with the proper data reporting flag when a project requires this type of data reporting.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Tables

The standard formulations contained in this Appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in hexane using Class A volumetric glassware and Hamilton syringes. Unless otherwise specified for a standard solution, assign an expiration date of 6 months from date of preparation unless the parent standard expires sooner in which case use the earliest expiration date. Store the prepared solutions under refrigeration and protected from light at a temperature of 4°C (±2). See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance.

Intermediate Calibration Standards (10 mg/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
AR1660[1]	Restek #32039	Aroclor 1016 Aroclor 1260	1000	0.40	40	10
AR1254	Restek #32011	Aroclor 1254	1000	0.40	40	10
AR1248	Restek #32010	Aroclor 1248	1000	0.40	40	10
AR1242	Restek #32009	Aroclor 1242	1000	0.40	40	10
AR1232	Restek #32008	Aroclor 1232	1000	0.40	40	10
AR1221	Restek #32007	Aroclor 1221	1000	0.40	40	10
AR1262	Restek #32409	Aroclor 1262	1000	0.40	40	10
AR1268	Restek #32410	Aroclor 1268	1000	0.40	40	10

[1] *Standard is a mix of AR1016/AR1260. Concentration shown is the concentration of each Aroclor in the mixed standard.*

Intermediate ICV Standard (10 mg/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
AR1660	Ultra Scientific PPM8082	Aroclor 1016 Aroclor 1260	1000	0.40	40	10

Surrogate Solution (10 mg/L)

Parent Standard	Vendor	Component	Stock Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (mg/L)
Pesticide Surrogate	Restek #3200	TCX DCB	1000	0.40	40	10

Working ICV Standard (200 ug/L)

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
Intermediate ICV	Laboratory Prepared	Aroclor 1016 Aroclor 1260	10	0.80	40	200
Surrogate	Laboratory Prepared	TCX DCB	10	0.080		20

AR1660 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1660 Intermediate	Laboratory Prepared	Aroclor 1016 Aroclor 1260	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1660 calibration standards*

AR1660 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1660 Level 5	AR1660 CAL Level 4	800	20	40	400
AR1660 Level 5	AR1660 CAL Level 3	800	10	40	200
AR1660 Level 5	AR1660 CAL Level 2	800	5.0	40	100
AR1660 Level 5	AR1660 CAL Level 1	800	2.5	40	50

AR1221 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1221 Intermediate	Laboratory Prepared	Aroclor 1221	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1221 calibration standards*

AR1221 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1221 Level 5	AR1221 CAL Level 4	800	20	40	400
AR1221 Level 5	AR1221 CAL Level 3	800	10	40	200
AR1221 Level 5	AR1221 CAL Level 2	800	5.0	40	100
AR1221 Level 5	AR1221 CAL Level 1	800	2.5	40	50

AR1232 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1232 Intermediate	Laboratory Prepared	Aroclor 1232	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1232 calibration standards*

AR1232 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1232 Level 5	AR1232 CAL Level 4	800	20	40	400
AR1232 Level 5	AR1232 CAL Level 3	800	10	40	200
AR1232 Level 5	AR1232 CAL Level 2	800	5.0	40	100
AR1232 Level 5	AR1232 CAL Level 1	800	2.5	40	50

AR1242 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1242 Intermediate	Laboratory Prepared	Aroclor 1242	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1242 calibration standards*

AR1242 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1242 Level 5	AR1242 CAL Level 4	800	20	40	400
AR1242 Level 5	AR1242 CAL Level 3	800	10	40	200
AR1242 Level 5	AR1242 CAL Level 2	800	5.0	40	100
AR1242 Level 5	AR1242 CAL Level 1	800	2.5	40	50

AR1248 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1248 Intermediate	Laboratory Prepared	Aroclor 1248	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1248 calibration standards*

AR1248 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1248 Level 5	AR1248 CAL Level 4	800	20	40	400
AR1248 Level 5	AR1248 CAL Level 3	800	10	40	200
AR1248 Level 5	AR1248 CAL Level 2	800	5.0	40	100
AR1248 Level 5	AR1248 CAL Level 1	800	2.5	40	50

AR1254 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1254 Intermediate	Laboratory Prepared	Aroclor 1254	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1254 calibration standards*

AR1254 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1254 Level 5	AR1254 CAL Level 4	800	20	40	400
AR1254 Level 5	AR1254 CAL Level 3	800	10	40	200
AR1254 Level 5	AR1254 CAL Level 2	800	5.0	40	100
AR1254 Level 5	AR1254 CAL Level 1	800	2.5	40	50

AR1262 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1262 Intermediate	Laboratory Prepared	Aroclor 1262	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1262 calibration standards*

AR1262 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1262 Level 5	AR1262 CAL Level 4	800	20	40	400
AR1262 Level 5	AR1262 CAL Level 3	800	10	40	200
AR1262 Level 5	AR1262 CAL Level 2	800	5.0	40	100
AR1262 Level 5	AR1262 CAL Level 1	800	2.5	40	50

AR1268 Calibration Standard: CAL Level 5 (800 ug/L)[1]

Parent Standard	Vendor	Component	Parent Standard Concentration (mg/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1268 Intermediate	Laboratory Prepared	Aroclor 1268	10	8.0	100	800
Surrogate	Laboratory Prepared	TCX DCB	10	0.80		80

[1] *This standard is the parent standard for each level of the AR1268 calibration standards*

AR1268 Calibration Standard(s): CAL Levels 1- 4

Parent Standard	Calibration Standard	Parent Standard Concentration (ug/L)	Volume Added (mL)	Final Volume (mL)	Final Concentration (ug/L)
AR1268 Level 5	AR1268 CAL Level 4	800	20	40	400
AR1268 Level 5	AR1268 CAL Level 3	800	10	40	200
AR1268 Level 5	AR1268 CAL Level 2	800	5.0	40	100
AR1268 Level 5	AR1268 CAL Level 1	800	2.5	40	50

Appendix C: Equations

Calibration Factor (CF_x) = $\frac{\text{Peak area or height}_{(x)}}{\text{Standard concentration}_{(ug/L)}}$

Mean Calibration Factor ($\overline{CF}$) = $\frac{\sum_{i=1}^{n} CF_i}{n}$

where: n = number of calibration levels

Standard Deviation of the Calibration Factor (SD) = $\sqrt{\frac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)2}{n-1}}$

where: n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor =
$\frac{SD}{\overline{CF}} \times 100\%$

Percent Difference (%D) = $\frac{CF_v - \overline{CF}}{\overline{CF}} \times 100\%$ Add absolute value signs

where: CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

Percent Drift = $\frac{\text{Calculated Concentration} - \text{Theoretical Concentration}}{\text{Theoretical Concentration}}$ X 100%

Percent Recovery (%R) = $\frac{C_s}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS/MSD = $\frac{C_s - C_u}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (RPD) = $\frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$

where: C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration

Extract

$$C_{extract}\,(ug/L) = \frac{\text{Peak Area (or Height)}}{\overline{CF}}$$

Note: The concentrations of the 3-5 peaks chosen for quantification is calculated and the average is then taken for final calculation.

Water

$$C_{sample}(ug/L) = C_{extract}(ug/L) \times \frac{\text{extract volume (L)}}{\text{sample volume (L)}} \times DF$$

Solid

$$C_{sample}(ug/Kg) = C_{extract}(ug/L) \times \frac{\text{extract volume (L)}}{\text{sample weight (Kg)}} \times \frac{100}{\%\,\text{solids}} \times DF$$

QAPP Worksheet #15
(UFP-QAPP Manual Section 2.8.1)

Reference Limits and Evaluation Table

Matrix: Solids [5,6]

Analytical Group: PCB Aroclors by SW846-8082A

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Quantitation Limit (ug/kg)[2]	Analytical Method		Achievable Laboratory Limits	
				MDLs	QLs	MDLs	CRQLs(ug/kg)[3,4]
Aroclor 1016	12674-11-2	Note 1	33	NA	17	2.2	17
Aroclor 1221	11104-28-2	Note 1	33	NA	17	2.6	17
Aroclor 1232	11141-16-5	Note 1	33	NA	17	1.6	17
Aroclor 1242	53469-21-9	Note 1	33	NA	17	1.3	17
Aroclor 1248	12672-29-6	Note 1	33	NA	17	1.9	17
Aroclor 1254	11097-69-1	Note 1	33	NA	17	1.3	17
Aroclor 1260	11096-82-5	Note 1	33	NA	17	3.3	17
Aroclor 1262	37324-23-5	Note 1	33	NA	17	5.0	17
Aroclor 1268	11100-14-4	Note 1	33	NA	17	1.0	17
Total PCB (Sum of all Aroclors)		1,000 (USEPA ROD criteria)[1]					

1. The USEPA soil cleanup criterion for total PCBs given in the ROD is 1.0 ppm (or 1,000 ug/kg).
2. The project quantitation limits for soils were based upon USEPA CLP CRQLs for soil given in CLP SOW SOM01.2.
3. The achievable Laboratory Limits as listed are based upon Test America Burlington detection limit studies.
4. To achieve the detection limits, at least 10 grams of a sample should be collected.
5. Solids samples will include either soils or interior dust.
6. Dust is assumed to be dry and sample size will be limited, therefore the data on dust samples will not be corrected for moisture content.

QAPP Worksheet #19

(UFP-QAPP Manual Section 3.1.1)

Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume/Mass per Analysis	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)[1]
Soils	PCBs	Low	SW846-8082A	At least 30 g;	4 oz. Glass Jar	Cool to 4 +/- 2 °C	14 days to extraction, 40 days to analysis Alternately soil samples can be stored frozen at -10° C for up to one year prior to analyses
Interior dust (Screened by lab through No. 100 mesh sieve)	PCBs	Low	SW846-8082A	If possible collect at least 10 g, but if necessary the lab can analyze smaller dust sample volumes[2]	The vacuum filters should be placed in a clean 32 oz. Glass, Amber Jar or sealable plastic bag. [3]	Cool to 4 +/- 2 °C	14 days to extraction, 40 days to analysis

1. Requested laboratory turn-around times (TATs) for the non-CLP test methods for the majority of the requested analyses will be within 3 business days of receipt of soil samples and 15 business days for dust samples.
2. Ideal and necessary volumes assume the removal via sieving of solid, non-dust particulates (i.e., pebbles, wood fragments, etc.). It is anticipated that any soil clumps will be broken apart prior to the screening process.
3. To make sure that sufficient dust mass is available for PCB Aroclor analyses, multiple vacuum filters should be collected per individual sample and should be placed together in the jar or sealed plastic bag. The field crew should record the weight of each filter before and after sample collection to determine the cumulative amount of dust that has been collected for analysis.

QAPP Worksheet #20

(UFP-QAPP Manual Section 3.1.1)

The following table summarizes by matrix, analytical group, and concentration level the number of field QC samples that will be collected and sent to the laboratory.

Field Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation SOP Reference[1]	Approximate No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS	No. of Field Blanks	No. of Equip. Blanks [4]	No. of PT Samples	Approximate Total No. of Samples to Lab
Soil	PCBs	Low	SW-846-8082A	141	1 duplicated per batch of 20 or less [1]	1 MS and I MSD per batch of 20 or less [3]	None	At least one aqueous Equipment blank per week	None	Est. 255[5] (147 initial plus QC)
Interior dust	PCBs	Low	SW-846-8082A (Screened by lab through No. 100 mesh sieve)	14 (approximate)	None planned[2]	None planned[2]	At least one vacuum filter proofed[4]	None	None	29

1. Field duplicates for soil samples will be taken from the same boring and depth.
2. Field duplicates and MS/MSD samples will not be collected for interior dust analyses due to the limited sample volumes available.
3. The subcontract lab requests three containers of the sample be submitted to the lab for soil sample selected for matrix spike and matrix spike duplicate analyses.
4. Aqueous equipment blanks will not be collected during the interior dust sample collection. Instead, the samples of the vacuum filters to be employed for collecting the dust samples will be proofed by the laboratory.
5. The number of soil samples collected will depend upon the PCB data reported on the initial samples Soil samples will be initially collected from approximately 141 locations. As described in text of the Field Modification No. 1, dependent upon the initial data, samples may also be collected at additional depths.

QAPP Worksheet #28-2
(UFP-QAPP Manual Section 3.4)

QC Samples Table

Matrix	Solids (Soil and Dust)
Analytical Group	PCB Aroclors
Concentration Level	Low
Sampling SOP	See FSP, SOPs 2 and 3
Analytical Method/ SOP Reference	SW846-8082A/SOP No. BR-GC-005, Rev. 11
Sampler's Name	Field Team
Field Sampling Organization	Louis Berger and ARCADIS-US/ Malcolm Pirnie
Analytical Organization	Test America Burlington, Vt.
No. of Sample Locations	Approx. 135 locations for soil sampling Approx. 14 properties for dust samplings

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[1]
Equipment and/or Field Blanks	At least one equipment blank a week for soils. For dust, the filters will be proofed at least once during the program. .	FSP and QAPP	Investigate source of contamination	Field Team Leader	Sensitivity/Accuracy	< QL
Field Duplicates	1 per 20 field samples \for soils. None for dust.[2]	FSP and QAPP	If the results exceed limits for the field replicate, this will be addressed by the Data Reviewer	Field Team Leader and or Laboratory	Precision	RPD 35% for duplicate values greater than or equal to 5 times the CRQL

QC Samples Table

Matrix	Solids (Soil and Dust)
Analytical Group	PCB Aroclors
Concentration Level	Low
Sampling SOP	See FSP, SOPs 2 and 3
Analytical Method/ SOP Reference	SW846-8082A/SOP No. BR-GC-005, Rev. 11
Sampler's Name	Field Team
Field Sampling Organization	Louis Berger and ARCADIS-US/ Malcolm Pirnie
Analytical Organization	Test America Burlington, Vt.
No. of Sample Locations	Approx. 135 locations for soil sampling Approx. 14 properties for dust samplings

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[1]
Initial Calibration	Before sample analysis, when CCVs indicate calibration in no longer valid; after major instrument maintenance	Per SOP BR-GC-005, Rev. 11, RSD for each analytes ≤ 20% or Liner Regression: r ≥ 0.005	Correct problem, reanalyze, repeat calibration	Assigned Lab	Accuracy	Per SOP BR-GC-005, Rev. 11, RSD for each analytes ≤ 20% or Liner Regression: r ≥ 0.005
Initial calibration verification	After initial calibration	Per SOP BR-GC-005, Rev. 11 % recovery ±20% from expected value	Correct problem and verify second source standard, If that fails, repeat initial calibration	Assigned Lab	Accuracy	% recovery ±20% from expected value

QC Samples Table

Matrix	Solids (Soil and Dust)
Analytical Group	PCB Aroclors
Concentration Level	Low
Sampling SOP	See FSP, SOPs 2 and 3
Analytical Method/ SOP Reference	SW846-8082A/SOP No. BR-GC-005, Rev. 11
Sampler's Name	Field Team
Field Sampling Organization	Louis Berger and ARCADIS-US/ Malcolm Pirnie
Analytical Organization	Test America Burlington, Vt.
No. of Sample Locations	Approx. 135 locations for soil sampling Approx. 14 properties for dust samplings

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[1]
Continuous Calibration Verification	Daily, every 10 samples, end of sequence	SOP BR-GC-005, Rev. 11 +/- 20% or less of true value	Investigate and correct. Reanalyze the samples.	Assigned Lab	Accuracy	+/- 20% or less of true value
Surrogate	Every Sample	Per BR-GC-005, Rev. 11, DCB 45-125% recovery TXC 30-130% recovery	Investigate and correct. Reanalyze the samples.	Assigned lab	Accuracy	DCB 45-125% recovery TXC 30-130% recovery

QC Samples Table

Matrix	Solids (Soil and Dust)
Analytical Group	PCB Aroclors
Concentration Level	Low
Sampling SOP	See FSP, SOPs 2 and 3
Analytical Method/ SOP Reference	SW846-8082A/SOP No. BR-GC-005, Rev. 11
Sampler's Name	Field Team
Field Sampling Organization	Louis Berger and ARCADIS-US/ Malcolm Pirnie
Analytical Organization	Test America Burlington, Vt.
No. of Sample Locations	Approx. 135 locations for soil sampling Approx. 14 properties for dust samplings

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[1]
Laboratory Control Samples (LCS)	Once batch of 20 samples or fewer samples	Per BR-GC-005, Rev. 11 Aroclor 1016 55-120% Arcolor 1260 55-125%	Check calculation. It may be necessary to re-calibrate to meet acceptance criteria.	Assigned lab	Accuracy	Aroclor 1016 55-120% Arcolor 1260 55-125%
Matrix Spike/Matrix Spike Duplicate	One per batch of 20 soil samples of less. None for dust.[2]	Per BR-GC-005, Rev. 11 Aroclor 1016 55-120%, RDP $\leq$ 30% Arcolor 1260 55-125%, RDP $\leq$ 30%	Evaluate data and determine if a matrix effect or analytical error is indicated. If analytical error, re-evaluate and or/extract. Flag all the reported data outside of control limits	Assigned lab	Accuracy/Bias/ Precision	Aroclor 1016 55-120%, RDP $\leq$ 30% Arcolor 1260 55-125%, RDP $\leq$ 30%

QC Samples Table

Matrix	Solids (Soil and Dust)
Analytical Group	PCB Aroclors
Concentration Level	Low
Sampling SOP	See FSP, SOPs 2 and 3
Analytical Method/ SOP Reference	SW846-8082A/SOP No. BR-GC-005, Rev. 11
Sampler's Name	Field Team
Field Sampling Organization	Louis Berger and ARCADIS-US/ Malcolm Pirnie
Analytical Organization	Test America Burlington, Vt.
No. of Sample Locations	Approx. 135 locations for soil sampling Approx. 14 properties for dust samplings

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[1]
Confirmation on second column	Every sample	Per BR-GC-005, Rev. 11	Investigate and correct, Reanalyze the samples	Assigned lab	Accuracy/Bias/ Precision	Sample results on two columns ≤25%
Method Blank	Each group of 20 field samples or less of the same matrix	Per BR-GC-005, Rev. 11, Less than RL	Correct problem and reanalyze blank	Assigned lab	Sensitivity	Less than RL
Method Detection Limits	Annually	Per BR-GC-005, Rev. 11, Low enough to support the RLs	Determine before analyzing samples	Assigned lab	Sensitivity	Low enough to support the RLs

1. The assigned laboratory also must perform all the QA/QC sample analyses and meet all the measurement performance criteria that assess the applicable DQIs specified in lab SOP per 8082A.
2. The lab will not perform field duplicate or MD/MSD sample analyses on dust samples, since insufficient sample volume will be available.

QAPP Worksheet #36

(UFP-QAPP Manual Section 5.2.2)

This worksheet and text section identifies the matrices, analytical groups, and concentration levels that each entity performing validation will be responsible for, as well as criteria that will be used to validate those data.

Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)[1]
IIa/IIb	Solids (soil and dust)	PCB Aroclors by SW-846-8082A	Low	SW-8082A and the QAPP acceptance limits based upon Test America Lab SOP BR-GC-005 using the EPA National Functional Guidelines as guidance for validation	Project chemist or experienced data validator (ARCADIS-US/Malcolm Pirnie)

Commercial Subcontractor Laboratory Data

Data generated by a commercial subcontractor laboratory will be validated by an ARCADIS-US/Malcolm Pirnie data reviewer or other qualified Louis Berger subcontractor. Parameters will be validated in accordance with the QC requirements in the QAPP (see lab QCs in Field Modification No. 1 Worksheet 28) using the guidance in the USEPA's National Functional Guidelines.

- USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, OPSWER 9240.1-46, USEPA-540-R-07-003, July 2007